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Revision 2A

# Radioactive Air Emissions Notice of Construction for the Transuranic Waste Retrieval Project

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

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**United States  
Department of Energy**  
P.O. Box 550  
Richland, Washington 99352

Project Hanford Management Contractor for the  
U.S. Department of Energy under Contract DE-AC06-96RL13200

Approved for Public Release  
(Upon receipt of Clearance approval)  
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*Chris Hallenham*  
Clearance Approval

10/9/03  
Date

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**TABLE**

Table 1.	Transuranic Waste Retrieval Project Point Source and Diffuse/Fugitive Release Rates and Dose Estimates. ....	T-1
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## TERMS

1		
2		
3		
4	ALARA	as low as reasonably achievable
5	ALARACT	as low as reasonably achievable control technology
6	APQ	annual possession quantity
7		
8	BARCT	best available radionuclide control technology
9		
10	CFR	Code of Federal Regulations
11	Ci	curie
12	cpm	counts per minute
13	CWC	Central Waste Complex
14	DVS	drum venting system
15		
16	DOE-RL	U.S. Department of Energy, Richland Operations Office
17	dpm/100 cm <sup>2</sup>	disintegrations per minute per 100 square centimeters
18		
19	EPA	U.S. Environmental Protection Agency
20		
21	HEPA	high-efficiency particulate air
22	HPT	health physics technician
23	HSGS	headspace gas sampling
24	HVU	HEPA-filtered vacuum unit
25		
26	LIGO	Laser Interferometer Gravitational Wave Observatory
27	LLBG	Low-Level Burial Grounds
28	LLW	low-level waste
29		
30	MEI	maximally exposed individual
31	mrem	millirem
32		
33	NOC	notice of construction
34		
35	PCM	periodic confirmatory measurements
36	PTE	potential-to-emit
37		
38	RWP	radiological work permit
39		
40	SEPA	<i>State Environmental Policy Act of 1971</i>
41		
42	TEDE	total effective dose equivalent
43	TRU	transuranic (waste)
44	TSD	treatment, storage, and/or disposal
45		
46	WAC	Washington Administrative Code
47	WDOH	Washington State Department of Health
48		
49	WIPP	Waste Isolation Pilot Plant
50	WRAP	Waste Receiving and Processing Facility
51		

## METRIC CONVERSION CHART

Into metric units

Out of metric units

If you know	Multiply by	To get	If you know	Multiply by	To get
<b>Length</b>			<b>Length</b>		
inches	25.40	millimeters	millimeters	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
<b>Area</b>			<b>Area</b>		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	hectares	hectares	2.47104	acres
<b>Mass (weight)</b>			<b>Mass (weight)</b>		
ounces (avoir)	28.34952	grams	grams	0.035274	ounces (avoir)
pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
<b>Volume</b>			<b>Volume</b>		
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
<b>Temperature</b>			<b>Temperature</b>		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
<b>Energy</b>			<b>Energy</b>		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
<b>Force/Pressure</b>			<b>Force/Pressure</b>		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Third Ed., 1990, Professional Publications, Inc., Belmont, California.

## NOTICE OF CONSTRUCTION HISTORY

The *Radioactive Air Emissions Notice of Construction for the Transuranic Waste Retrieval Project*, Revision 1, was submitted to the Washington State Department of Health (WDOH) and the U.S. Environmental Protection Agency (EPA), Region 10, on December 18, 2001 (02-RCA-096).

Revision 1 dealt with transuranic (TRU) waste containers that were drums only. Retrieval of TRU waste boxes was deferred to a later approval. This revision addresses retrieval of TRU boxes and other containerized waste in addition to the drums addressed by Revision 1. In addition, this revision updates the process description and controls for soil removal related to retrieval.

Venting of containers is further discussed in terms of constructing a new point source for emissions, an enclosure used to enhance occupational work conditions and control potential emissions. Diffuse and fugitive emissions are also addressed, in which case NucFil® filters and/or sample ports are installed by a proven system minimizing the risk of contamination release. In addition, this revision includes some description of low-level waste (LLW) management and describes operations involving headspace gas sampling (HSGS) and NucFil filter and/or sample port installation/replacement. These HSGS and filter replacement activities could be or currently are performed at other Hanford Site treatment, storage, and/or disposal (TSD) units, i.e., T Plant, the Central Waste Complex (CWC), or the Waste Receiving and Processing Facility (WRAP).

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NucFil® is a registered trademark of Nuclear Filter Technology, Inc., Lakewood, Colorado.



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5  
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**RADIOACTIVE AIR EMISSIONS NOTICE OF CONSTRUCTION  
FOR THE TRANSURANIC WASTE RETRIEVAL PROJECT**

This revision serves as a notice of construction (NOC) pursuant to the requirements of Washington Administrative Code (WAC) 246-247-060, and as a request for approval to construct pursuant to 40 Code of Federal Regulations (CFR) 61.07, for retrieving and handling of containers of TRU and suspect-TRU waste currently buried at the Low-Level Burial Grounds (LLBG).

Since 1970, approximately 38,000 suspect-TRU and TRU waste containers have been placed in retrievable storage on the Hanford Site in the 200 Areas burial grounds. The majority of TRU waste containers on the Hanford Site (estimated to be approximately 28,000) are located in outdoor trenches in the LLBG, in which the containers had been stacked upright on asphalt pads and then covered with earth (Figure 3).

The major activity under the TRU waste retrieval project is to retrieve and handle TRU waste stored in containers at the LLBG as described in *Process Description for the Retrieval of Earth Covered TRU Waste Containers at the Hanford Site* (HNF-5597). These containers will be retrieved, visually inspected for structural integrity, and, if necessary, placed in an overpack container during the retrieval phase. Waste will be categorized as TRU (including mixed waste) or LLW (including mixed waste) through a records review or nondestructive assay. Unvented containers containing TRU material will be vented (either within the LLBG as proposed, or at another TSD unit approved for such work). Inadequately vented TRU containers (i.e., vent clips or plugged filters) could also be vented. Retrieved TRU containers will be transported from the LLBG to an existing TSD unit (Containers for which there is no disposition pathway will be left in the LLBG). The TSD unit for this operation is expected to be the CWC; however, the WRAP Facility and T Plant Complex also could be used to manage specific container issues before acceptance at CWC. At CWC, the containers will be stored for certification activities to support disposal at the Waste Isolation Pilot Plant (WIPP). The containers determined to be LLW will be disposed in the LLBG or transferred to another TSD unit or other approved facility. A small percentage of TRU waste containers is expected to require special handling (described further in Section 5.0).

This NOC is intended to cover the excavation activities associated with retrieval of waste containers as well as activities associated with assaying containers and installing NucFil filters or equivalent in the retrieved containers lacking proper venting devices.

Section 15.0 of this NOC discusses the estimated total effective dose equivalent (TEDE) to the offsite maximally exposed individual (MEI) resulting from the unabated and abated emissions from these new activities.

The public maximally exposed individual (MEI) location with respect to the 200 East Area is located at Energy Northwest (commercial power production facility on the Hanford Site) and with respect to the 200 West Area is located at the Laser Interferometer Gravitational Wave Observatory (LIGO). The unit dose conversion factors (HNF-3602), using the CAP88 PC computer model with Hanford Site specific default values, were used to calculate the potential TEDE to the MEI. The MEI location at LIGO is more restrictive than the MEI location at Energy Northwest. Therefore, the MEI location for the LLBG is considered LIGO, regardless of whether activities take place in 200 East Area or 200 West Area.

1 **1.0 LOCATION**

2 *Name and address of the facility, and location (latitude and longitude) of the emission unit(s).*

3  
4 The LLBG are located in the 200 West and 200 East Areas (Figure 1). The address and representative  
5 geodetic coordinates for the LLBG (representing 200 West LLBG, adjacent 200 West TSD facilities, and  
6 including activities at 200 East LLBG) are:

7  
8 U.S. Department of Energy, Richland Operations Office (DOE-RL)  
9 Hanford Site  
10 Richland, Washington 99352  
11 200 West Area

12  
13 46° 34' North Latitude  
14 119° 38' West Longitude.  
15  
16

17 **2.0 RESPONSIBLE MANAGER**

18 *Name, title, address, and phone number of the responsible manager.*

19  
20 Matthew S. McCormick  
21 Assistant Manager for the Central Plateau  
22 U.S. Department of Energy, Richland Operations Office  
23 P. O. Box 550  
24 Richland, Washington 99352  
25 (509) 373-9971.  
26  
27

28 **3.0 PROPOSED ACTION**

29 *Identify the type of proposed action for which this application is submitted.*

- 30 a. *Construction of new emission unit(s), or*  
31 b. *Modification of existing emission unit(s); identify whether this is a significant modification.*  
32

33 The proposed action is to retrieve (unearth) and inspect containers of suspect-TRU and TRU waste from  
34 trenches in the LLBG and install NucFil filters or equivalent in the unvented (or inadequately vented)  
35 TRU containers. Venting and HSGS could be performed at the LLBG (in place with engineering controls  
36 or within venting enclosure) or at another TSD unit already approved for such work (CWC, WRAP, or  
37 T Plant Complex). In addition, LLW containers posing a safety hazard (e.g., potential for pressurization,  
38 bulging, or similar abnormal condition) could also be vented. As such, a modified (insignificant) source  
39 for diffuse and fugitive emissions and a new portable point source for emissions will be created.  
40  
41

42 **4.0 STATE ENVIRONMENTAL POLICY ACT**

43 *If this project is subject to the requirements of the State Environmental Policy Act (SEPA) contained in*  
44 *chapter 197-11 WAC, provide the name of the lead agency, lead agency contact person, and their phone*  
45 *number.*  
46

47 The proposed action categorically is exempt from the requirements of SEPA under WAC 197-11-845.  
48

## 5.0 PROCESS DESCRIPTION

*Describe the chemical and physical processes upstream of the emission unit(s).*

A description of the retrieval activities is provided in the following sections. These activities are summarized in a simplified process flow diagram in Figure 2.

### 5.1 Excavation and Retrieval of Containers

The area to be excavated is managed as a 'clean' area, free of surface contamination measurable with field survey instruments. Because of the possibility of encountering previously undetected subsurface contamination, or future contamination from windblown sources, all work will be performed in accordance with as low as reasonably achievable (ALARA) requirements as determined by the Radiological Control organization. These requirements are carried out through the activity work packages and associated radiological work permits (RWP).

The overburden soil will be removed to expose the waste containers. Excavation equipment will be chosen to effectively remove soil and retrieve the waste containers while minimizing damage to the containers. Excavation activities will be monitored to identify contamination that might be present and to minimize emissions. Any contaminated soils will be managed in accordance with applicable requirements and regulations.

The most efficient methodology for removing the uncontaminated overburden from the containers will include the maximum use of conventional methods such as backhoes, frontend loaders, mechanical brooms (boom mounted), or manual digging with shovels and similar hand tools. Hand tools predominantly will be used to excavate contaminated soil. High-efficiency particulate air (HEPA) filtered vacuums could be used for spot contamination in accordance with the HEPA-filtered vacuum unit (HVU) NOC (DOE/RL-97-50, as amended).

The typical storage configuration of retrievably stored TRU waste is depicted in Figure 3. The specific steps or approach to uncovering the containers will vary according to the configuration of the trench to be uncovered, the nearby trenches or fences, the designated location of the spoils pile, the planned extent of the soil removal, etc. Therefore, excavation activities will be planned before arriving at the job site. Excavation activities will be controlled closely. When the quantity of soil removed with heavy equipment has reached the logical end, hand tools or HVUs could be used to complete the uncontaminated soil removal operations to access and remove the plastic and plywood materials (to be set aside for reuse or disposal) covering the containers.

The exposed containers will be visually inspected and surveyed for contamination. Abnormal drum conditions will be managed as follow: Contaminated containers will be decontaminated or overpacked as needed. Bulging or potentially pressurized containers will be vented as described in Section 5.2. Retrieval activities will include appropriate disposition of small amounts of incidental contaminated soil (e.g., containerized or fixed in place). Larger areas of contamination could be fixed and the area posted as required by the Radiological Control organization for later disposition. Bulk transfer of contaminated soils for disposal in another trench also could occur.

All containers will be inspected to verify integrity. The container inspection will consist of a visual examination to determine if there are significant corrosion, holes, dents or other visual deformities. All containers could be moved, turned, or otherwise relocated (manually or with powered equipment, slings, clamps, or appropriate rigging) to facilitate an adequate visual inspection.

Overpacking containers with minor defects (pinholes, corrosion) is routinely performed at the LLBG and CWC and is expected for up to 10 to 50 percent of the retrieved containers. Precautions will be provided to safely retrieve containers of questionable integrity (abnormal conditions, described further in Sections 6.1, 10.3, and 13.3). The process description for management of abnormal containers will be maintained in written procedures. Operating procedures will be established to safely deal with these containers. Containers that obviously are breached or deformed also will be safely removed. Removal methods will be determined on a case-by-case basis. A breached container that can provide secure confinement will be relocated to an area for repackaging or overpacking. If the container cannot provide adequate confinement for the contents, the container and contents will be overpacked before being relocated. The overpacked containers will be managed according to the LLW (including mixed waste) or TRU waste designation (TRU containers are those with TRU content greater than 100 nCi/g), established by records or assay.

After a container is inspected visually and the structural integrity established, the container (if shown by assay or records to be designated as TRU) will be staged for venting, if necessary, or moved to another TSD unit for venting. Retrieved TRU waste containers in their staged configuration at the LLBG will be inspected for outwardly visible signs of corrosion or degradation (overpacking as needed).

## 5.2 Venting of Containers

All work will be performed in accordance with the LLBG radiological control procedures and ALARA requirements. These requirements are carried out through the procedures, activity work packages, and associated RWP.

The vent filters will be installed in designated containers via a proven process [Drum Venting System (DVS) and/or Dart System] that ensures personnel and environmental protection. The methodology will require penetrating the container and inserting a vent. Penetration of the lid will be accomplished by either drilling through the lid with a filter assembly fitted with a short hollow drill bit (using DVS) or puncturing the lid with a filter dart (using Dart system). Either method will result in emissions being routed through a filter during the venting process.

Most drums slated for venting will be vented with the DVS (Figure 4), consisting of a trailer with a chamber allowing an operator to sample the drum (screening HSGS for hydrogen content) and install a NucFil filter. Potential emissions from these operations are point source emissions, controlled as described in Section 6.2.

Bulging or potentially pressurized drums will be evaluated to determine best method and location to vent (Dart-in place, Dart-relocate, or move to the DVS). The Dart System is a portable unit that straps directly onto a drum, using a pneumatic driver remotely activated by wire or radio transmitter. This system penetrates the drum lid without risk of contamination release to install a NucFil filter with an aluminum bronze housing to prevent the possibility of sparking. Potential emissions from these operations will be considered diffuse and fugitive. The same Dart System will be used to install sample ports, consisting of a closure set screw covering a septum for withdrawing a sample for HSGS, in containers with existing vents at the LLBG, CWC, WRAP, or T Plant Complex, without creating a new pathway for potential emissions.

The NucFil venting/sample port installation technology (both cold drilling and dart insertion approaches) is well proven, having been used successfully across the DOE complex and commercial nuclear and chemical industry to install vents and/or sample ports in hundreds of thousands of drums and other containers.

## 6.0 PROPOSED CONTROLS

*Describe the existing and proposed (as applicable) abatement technology. Describe the basis for the use of the proposed system. Include expected efficiency of each control device, and the annual average volumetric flow rate(s) in meters<sup>3</sup>/sec for the emission unit(s).*

Many of the emission controls used for the diffuse and fugitive emissions during the TRU waste retrieval activities will be administrative, based on ALARA principles and consist of ALARA techniques. It is proposed that these controls as described below be approved as best available radionuclide control technology (BARCT) for retrieval and venting of suspect-TRU waste containers.

### 6.1 Excavation and Retrieval of Containers

Health physics technician (HPT) coverage will be provided during the excavation activities, continuously when in close proximity to containers. Soil surveys for radioactive contamination will be performed for alpha and/or beta/gamma. Appropriate controls such as water, fixatives, covers, or windscreens will be applied, if needed, as determined by the Health Physics organization. Spoil piles containing contaminated soil will be segregated from the clean soil. Containerizing spoils for disposal also could be performed. Operational limitations (windspeed) for TRU retrieval activities will be by LLBG operating methods, procedures, and/or work packages.

Manual methods described in Section 5.1 will be used to excavate soil in close proximity to containers (after overburden is removed). Operational limits for TRU retrieval (contamination levels) will be established in the activity work packages and associated RWPs. Fixatives or other controls will be employed if contamination levels (other than spot contamination) exceed 100,000 disintegrations per minute per 100 square centimeters (dpm/100 cm<sup>2</sup>) beta-gamma or exceed 2,000 dpm/100 cm<sup>2</sup> alpha. Excavation activities will be stopped if contamination (other than spot contamination) with detection readings greater than 500,000 dpm/100 cm<sup>2</sup> beta-gamma or greater than 28,000 dpm/100 cm<sup>2</sup> alpha is encountered. Excavation will not continue at that site (but may proceed at other sites) until an internal review of the work and encountered conditions has been performed and an internal determination has been made that no threat to personnel safety or the environment exists, or until proper controls (i.e., removal and disposal, water, fixatives, or covers) have been put in place to mitigate any further potential for emissions. WDOH will be notified per WAC 246-247-080(5) if a loss of containment occurs (dropping, spilling, puncturing a container, or otherwise encountering loss of integrity where contamination escapes containment), which exceeds 100,000 dpm/100 cm<sup>2</sup> beta-gamma or 2,000 dpm/100 cm<sup>2</sup> alpha removable contamination.

Use of HVUs for control of localized spot contamination will be done in accordance with the latest approved version of the HVU NOC (DOE-RL-97-50).

### 6.2 Venting of Containers

Container surface surveys/smears for radioactive contamination will be performed for alpha and/or beta/gamma during the inspection/retrieval activities and before transfer to a TSD. HPT coverage will be provided during the venting activities.

The DVS has a testable HEPA-type filter for all emissions resulting from screening HSGS for hydrogen content and NucFil filter installation. Metal filings or other residual cuttings from the drilling/filter installation process are removed from the drum lid with a HEPA vacuum. The test compartment is

1 passively ventilated with a HEPA-type filter and is designed to withstand a deflagration as described in  
2 the performance specification for this venting system (HNF-12180).

3  
4 The average annual flow for the exhaust port for the venting and HSGS operations shown in Figure 4 is  
5 approximately  $1 \text{ E-}4 \text{ m}^3/\text{s}$  (consisting of a continuous flow in the milliliter per second range, with  
6 intermittent spikes in the liter per second range). The HEPA vacuum exhausts intermittently into the test  
7 chamber (at less than 300 cfm, or  $1.4 \text{ E-}1 \text{ m}^3/\text{s}$ ). The test chamber shown in Figure 4 is passively vented.

8  
9 The Dart System is designed to insert a non-sparking NucFil filter or sample port remotely and nearly  
10 instantaneously (insertion time in milliseconds), even if the container is pressurized. Containers that  
11 already have NucFil filters installed may have NucFil sample ports installed (allowing subsequent HSGS  
12 collection) without creating a new pathway for potential emissions. Sample ports may be installed in  
13 drums with existing NucFil filters using the Dart System at the LLBG, CWC, WRAP, or T Plant  
14 Complex.

15  
16 The HEPA-type NucFil filters are not testable once installed, but are certified by the manufacturer as  
17 HEPA rated (99.97 % removal efficiency, flow rate in the range of  $1 \text{ E-}6$  to  $3 \text{ E-}6 \text{ m}^3/\text{s}$ ).

## 18 19 20 **7.0 DRAWINGS OF CONTROLS**

21 *Provide conceptual drawings showing all applicable control technology components from the point of*  
22 *entry of radionuclides into the vapor space to release to the environment.*

23  
24 Drawings of controls for the diffuse and fugitive emissions are not applicable because the emission  
25 controls to be used during these activities are defined administratively, based on ALARA principles and  
26 consist of ALARA techniques. A schematic of the DVS is provided in Figure 4. More detailed  
27 information on the NucFil equipment (considered proprietary) will be provided as supplemental  
28 information to WDOH when it becomes available.

## 29 30 31 **8.0 RADIONUCLIDES OF CONCERN**

32 *Identify each radionuclide that could contribute greater than ten percent of the potential-to-emit TEDE to*  
33 *the MEI, or greater than 0.1 mrem/yr potential-to-emit TEDE to the MEI.*

34  
35 The radionuclides of concern exist as particulates. All radionuclides are assumed to be conservatively  
36 represented by either americium-241 or cesium-137. This assumption provides a conservative estimate of  
37 the potential-to-emit (PTE) from the vented containers. Radionuclides that could contribute greater than  
38 ten percent of the PTE include strontium-90, cesium-137, plutonium 239/240, and americium-241, but are  
39 conservatively represented by cesium-137 and americium-241. Other radionuclides expected to be  
40 encountered are cesium-134, europium-152, europium-154, uranium-234, uranium-235, uranium-236,  
41 uranium-238, plutonium-238, plutonium-241, americium-243, curium-244, and californium-252. Any  
42 radionuclide isotope could be encountered.

## 43 44 45 **9.0 MONITORING**

46 *Describe the effluent monitoring system for the proposed control system. Describe each piece of*  
47 *monitoring equipment and its monitoring capability, including detection limits, for each radionuclide that*  
48 *could contribute greater than ten percent of the potential-to-emit TEDE to the MEI, or greater than*  
49 *0.1 mrem/yr potential-to-emit TEDE to the MEI, or greater than twenty-five percent of the TEDE to the*

*MEI, after controls. Describe the method for monitoring or calculating those radionuclide emissions. Describe the method with detail sufficient to demonstrate compliance with the applicable requirements.*

The potential unabated offsite dose associated with this activity for normal operations is calculated to be less than 0.1 millirem per year. Therefore, in accordance with 40 CFR 61, Subpart H, periodic confirmatory measurements (PCM) will be made to verify the low emissions. The 200 Area Diffuse/Fugitive emission unit (which includes the LLBG) is considered by WDOH as a major, non-point emission source. The existing 200 Area network system for near-field monitoring (DOE/RL-91-50) will be used to verify low emissions during TRU waste retrieval.

Additional monitoring for the diffuse and fugitive emissions will consist of radiological surveys from the soil excavation activities. The survey methods for monitoring are not a direct measurement of effluent emissions. The methods are intended to demonstrate compliance by showing that by being under the contamination levels by which work is controlled, the actual emissions inherently would be below the estimated emissions, which are based on (calculated from) the same contamination levels.

HVUs used for spot contamination or cleaning tops of drums will use logsheets and monitoring (smears and surveys) in accordance with the NOC for these units (DOE/RL-97-50, as amended). The HVU used inside the DVS is exempt from the HVU NOC requirements.

Smears of the active exhaust port of the DVS will be performed after each day of use to verify low emissions from point sources. Smears of the passive port will be performed on a weekly basis while in use to verify low emissions.

## **10.0 ANNUAL POSSESSION QUANTITY**

*Indicate the annual possession quantity for each radionuclide.*

The annual possession quantity (APQ) and annual handling limits are discussed in the following sections. The APQ is provided strictly as the basis for a conservative estimate of the PTE, not a limit.

It is conservatively estimated that the average amount of radionuclides in any one container (drum equivalent) will not exceed 20 curies (DOE/RL-2000-34, Rev. 1). It further is estimated that the alpha emitters would make up approximately 1.25 curies and the beta/gamma emitters would make up approximately 18.75 curies on average in any container. A maximum of 20,000 containers (drum equivalents) will be managed per year at the LLBG under this TRU retrieval NOC for an estimated APQ of 25,000 curies (Ci) of alpha and 375,000 Ci of beta/gamma.

## **10.1 Staging and Handling of Retrieved Containers**

An estimated maximum of 10,000 containers of TRU waste will be retrieved during the peak year of this project. TRU waste containers are considered retrieved when transferred to CWC. An additional 10,000 containers (drum equivalents) that are not designated as TRU waste could be relocated or retrieved as well. Of these, 9,000 are estimated as LLW containers that are not vented (although not technically meeting the definition of 'sealed' containers, WDOH has recognized them as closed containers such that potential emissions from these non-vented containers need not be addressed). The remaining estimated 1,000 containers are non-TRU containers that are already vented or are will be vented at the LLBG. Thus, a total of 11,000 vented containers are used for calculating release rates in Section 13.1 for staging and handling operations for vented containers.



## 10.2 Venting of Containers

It is estimated that a maximum of 9,000 containers of TRU waste will require installation of venting devices each year using the DVS. An additional 1,000 containers could require installation of NucFil filters using the Dart System. Either system could be used for containers that use the older vent clips or appear to be plugged. In addition, up to 10,000 NucFil sample ports could be installed using the Dart System in containers that already have NucFil filters. This would occur in the 200 West Area (LLBG, CWC, WRAP, or T Plant Complex). Thus, a total of 9,000 vented containers are used for calculating release rates in Section 13.2 for point source emissions and 1,000 vented containers for diffuse and fugitive emissions from venting operations. Installation of sample ports in already vented containers does not create a new pathway for potential emissions under normal operations.

## 10.3 Excavation and Retrieval of Containers

Trenches configured as shown in Figure 3 are not expected to have contaminated soil in contact with the drums. However, one trench configuration had drums placed horizontally in a V-notched trench, with soil used to fill the void spaces between containers, which deserves special consideration. Although retrieval from this particular trench configuration is not planned in the near future, it does provide a bounding estimate for encountering contaminated soil as follows:

For this hypothetical situation, the bounding estimate of a maximum of 2,500 containers of TRU waste per year is assumed to be retrieved from a horizontal trench (included in the totals for Sections 13.1 and 13.2). These containers have been in direct contact with soil. An estimated 1,000 m<sup>3</sup>/year of soil overburden above these 2,500 containers would be removed that has not been in contact with the TRU waste containers, which is considered clean overburden with minimal potential for contamination. The volume occupied by 2,500 containers (drum equivalent) is approximately 500 m<sup>3</sup>. An estimated 100 m<sup>3</sup> of soil occupies the void spaces between the containers. The integrity of the containers is expected to be quite good (HNF-3580; HNF-7165). A conservatively estimated 100 m<sup>3</sup> of the soil in contact with the containers is assumed to be contaminated at detectable levels (100 dpm/100 cm<sup>2</sup> TRU and 5,000 dpm/100 cm<sup>2</sup> beta direct readings). A smaller percentage, 10% of the contaminated soil (i.e., 10 m<sup>3</sup>), is assumed to be contaminated at higher levels (2,000 dpm/100 cm<sup>2</sup> alpha and 100,000 dpm/100 cm<sup>2</sup> beta). Contamination at the notification levels is not expected. However, as a contingency planning estimate, 1% of the contaminated soil (i.e., 1 m<sup>3</sup>) is assumed to be contaminated at notification levels (28,000 dpm/100 cm<sup>2</sup> alpha and 500,000 dpm/100 cm<sup>2</sup> beta). These volumes and contamination levels are used in Section 13.3 to calculate release rates from the horizontal trench operations.

## 11.0 PHYSICAL FORM

*Indicate the physical form of each radionuclide in inventory: Solid, particulate solids, liquid, or gas.*

The physical form of the radionuclides is particulate solid. Although none is expected, a negligible fraction of gaseous or liquid radionuclides could be encountered in the TRU waste retrieval project; however, if encountered, it would not provide a numeric change to the estimate of total curies.

## 12.0 RELEASE FORM

*Indicate the release form of each radionuclide in inventory: Particulate solids, vapor, or gas. Give the chemical form and ICRP 30 solubility class, if known.*

The release form of the radionuclides is particulate solid. Although none is expected, a negligible fraction of gaseous radionuclides could be encountered in the TRU waste retrieval project; however, if encountered, it would not provide a numeric change to the estimate of total curies.

## 13.0 RELEASE RATES

*Release Rates: a. New emission unit(s): Give predicted release rates without any emission control equipment (the potential-to-emit) and with the proposed control equipment using the efficiencies described in subsection (6) of this section, or b. Modified emission units(s): Give predicted release rates without any emissions control equipment (the potential-to-emit) and with the existing and proposed control equipment using the efficiencies described in subsection (6) of this section. Provide the latest year's emissions data or emissions estimates.*

The TEDE to the Hanford Site MEI from all calendar year 2001 U.S. DOE Hanford Site air emissions (point sources and diffuse and fugitive sources) was 0.49 millirem (DOE/RL-2002-20). The emissions resulting from the activities covered by this NOC, in conjunction with other operations on the Hanford Site, will not result in exceeding the National Emission Standard of 10 millirem per year (40 CFR 62, Subpart H).

Release rates resulting from the retrieval and venting activities are expected to be low and are described in the following sections.

### 13.1 Staging of Retrieved Containers

A maximum of 11,000 containers of waste (including 1,000 containers that are not designated as TRU waste, which could be retrieved with vents in place) will be retrieved per year. Once vented, the containers will be staged with the other retrieved containers for further handling, resulting in the staging/storage of a maximum of 11,000 vented containers per year at the LLBG. Using an average release fraction of  $2.00 \text{ E-}09$  for fugitive emissions from vented containers (as used in the WRAP NOC, DOE/RL-2000-34), the potential unabated release rate from the staging of vented containers is  $2.8 \text{ E-}05 \text{ Ci/yr}$  americium-241 and  $4.1 \text{ E-}04 \text{ Ci/yr}$  cesium-137 as shown in Table 1. No credit is taken for abatement; therefore, the abated emissions are assumed as the unabated emissions.

## 13.2 Installation of Drum Vents

A maximum of 9,000 containers of TRU waste will be processed per year using the DVS. The processing rate is designed to be 3 to 6 drums per hour, or a maximum time of 20 minutes per drum. Only one drum is processed at a time per DVS unit (although only one unit is planned, a second unit could be acquired to achieve processing rates of 9,000 containers per year). Using a release fraction of  $1.0 \text{ E-3}$  for particulates and a time factor of  $1.9 \text{ E-1}$  (20 minutes per container multiplied by 9,000 containers and divided by 526,000 minutes per year), the potential unabated release rate from using the DVS is  $4.3 \text{ E-4 Ci/yr}$  americium-241 and  $6.4 \text{ E-3 Ci/yr}$  cesium-137 as shown in Table 1. The DVS has a testable HEPA rated filter (99.95% removal efficiency, tested annually); therefore, the abated release rate is  $2.1 \text{ E-7 Ci/yr}$  americium-241 and  $3.2 \text{ E-6 Ci/yr}$  cesium-137, as shown in Table 1. The time factor is very conservative, as the actual HSGS screening process takes place in 30 to 40 seconds. The remainder of the time is spent on purging the sample lines and detectors with inert gases and setting up for the next container. The venting system is functionally equivalent in purpose, capabilities, and release rates as the modular containment at CWC approved for sampling activities up to 10,000 containers per year in support of WIPP certification.

The passive vent of the DVS exhausts potential emissions from using the HVU mounted in the test chamber to collect metal filings after installation of a NucFil filter. In accordance with the HVU NOC (DOE/RL-97-50, as amended), release rates are calculated by multiplying surface area vacuumed by the contamination level. Very few incidents of contamination have been encountered during the DVS use at other DOE sites. A very conservative estimate of release rates is calculated by assuming the surface area of the boot that covers the drum lid during the filter installation process (8.3 square inches) multiplied by 9,000 drums with an average contamination level of  $10,000 \text{ dpm/100 cm}^2$  beta/gamma and  $200 \text{ dpm/100 cm}^2$  alpha. Using a release fraction of 1.0 for HVU use, the potential unabated release rate from using the DVS is  $4.3 \text{ E-7 Ci/yr}$  americium-241 and  $2.2 \text{ E-05 Ci/yr}$  cesium-137 as shown in Table 1. The passive vent of the DVS has a testable HEPA rated filter (99.95% removal efficiency, tested annually); therefore, the abated release rate is  $2.2 \text{ E-10 Ci/yr}$  americium-241 and  $1.1 \text{ E-8 Ci/yr}$  cesium-137, as shown in Table 1.

A maximum of 1,000 containers will have installation of NucFil filters using the Dart System. This nearly instantaneous filter/sample port insertion system installs a NucFil filter in milliseconds. A conservative time estimate for pressure release during each installation is 1 hour. Using a release fraction of  $1.0 \text{ E-3}$  for particulates and a time factor of  $1.1 \text{ E-1}$  (60 minutes per container multiplied by 1,000 containers and divided by 526,000 minutes per year), the potential unabated release rate from using the Dart System for installation of NucFil filters is  $1.4 \text{ E-4 Ci/yr}$  americium-241 and  $2.1 \text{ E-3 Ci/yr}$  cesium-137 as shown in Table 1. All of the emissions from a pressurized container are routed through the HEPA-type NucFil filter (certified 99.97% removal efficiency); therefore, the abated release rate is  $4.8 \text{ E-8 Ci/yr}$  americium-241 and  $7.1 \text{ E-7 Ci/yr}$  cesium-137, as shown in Table 1.

## 13.3 Excavation and Retrieval of Containers

Although the exact condition of the waste containers is not known, there are indications from studies that indicate a high level of integrity for drums (HNF-3580; HNF-7165). Encountering contamination is not expected during excavation; therefore, to determine a potential to emit if contamination is encountered, the administrative control points set in Section 6.1 for contamination, as monitored by standard radiological field instrumentation, will be used to bound emissions. The  $500,000 \text{ dpm/100 cm}^2$  beta/gamma control point correlates to 50,000 counts per minute (cpm) as used in the calculations, and  $28,000 \text{ dpm/100 cm}^2$  above background alpha correlates to 4,000 cpm. To determine the corresponding soil concentration in picocuries per grams of individual radionuclides, conversion factors, as developed in *Soil Contamination Standards for Protection of Personnel* (HNF-2418) were used. The average soil

density was assumed to be 98 pounds per cubic foot. The beta-gamma contributing radionuclides were assumed to be represented by Cs-137 and the alpha contributing radionuclides were assumed to be represented by Am-241 (predominant alpha contributing radionuclide in the soil is unknown; therefore, assumption of Am-241 will produce the most conservative dose consequence). The respective volumes of contaminated soil (i.e., 100 m<sup>3</sup>, 10 m<sup>3</sup>, and 1 m<sup>3</sup>) at the three contamination levels described in Section 10.3 are considered as released from manual excavation, using a release fraction of 1.0 E-3.

The potential unabated release rate from manual excavation is 1.9 E-4 Ci/yr americium-241 and 1.3 E-3 Ci/yr cesium-137 as shown in Table 1. Although fixatives and similar controls would be employed for the higher contamination level and notification level contamination as described in Section 6.1, no credit is being taken for abatement; therefore, the abated release rate is the unabated release rate, as shown in Table 1.

HVU use as described in Section 10.3 is assumed as 1 % of the total unabated release rates for manual excavation, but a release fraction of 1.0 is used instead of the 1 E-3 release fraction used for manual excavation. This yields a potential unabated release rate of 1.9 E-3 Ci/yr americium-241 and 1.3 E-2 Ci/yr cesium-137 as shown in Table 1. HVUs are tested at 99.95% removal efficiency; therefore, the abated release rate is 9.7 E-7 Ci/yr americium-241 and 6.4 E-6 Ci/yr cesium-137, as shown in Table 1.

The release rates discussed thus far do not address encountering deteriorated containers involving a loss of containment from handling/retrieval of such containers (dropping, spilling, puncturing or crushing a container, where containment is lost, or otherwise encountering loss of containment). Such conditions are not expected in normal operations, particularly with the trench configuration shown in Figure 3. The probability that they would occur at some point will likely be greater than 1% for the bounding scenario as described in Section 10.3. Planning for such incidents will be addressed as part of the next phase of the NOC approval prior to performing retrieval work in the horizontal V-notched trench configuration. Accidents involving a loss of containment as described in Section 6.1 will include notification to WDOH.

#### 14.0 LOCATION OF MAXIMALLY EXPOSED INDIVIDUAL

*Identify the MEI by distance and direction from the emission unit(s). The MEI is determined by considering distance, windrose data, presence of vegetable gardens, and meat or milk producing animals at unrestricted areas surrounding the emission unit.*

The onsite public MEI location with respect to the 200 West Area is Laser Interferometer Gravitational Wave Observatory (LIGO). The onsite public MEI location with respect to the 200 East Area is Energy Northwest. The LIGO MEI is more restrictive than the Energy Northwest MEI; therefore, the LIGO MEI will be used for both 200 East and 200 West Areas TRU retrieval activities. This MEI is approximately 18.3 kilometers east-southeast of a release location in 200 West.

#### 15.0 TOTAL EFFECTIVE DOSE EQUIVALENT TO THE MAXIMALLY EXPOSED INDIVIDUAL

*Calculate the TEDE to the MEI using an approved procedure (see WAC 246-247-085). For each radionuclide identified in subsection(8) of this section, determine the TEDE to the MEI for existing and proposed emission controls, and without emission controls (the potential-to-emit) using the release rates from subsection (13) of this section. Provide all input data used in the calculations.*

Using the unit dose factors provided in HNF-3602 and the release rates from Section 13.0, estimated potential abated and unabated TEDE to the MEI is shown in Table 1. The unabated dose from point

source emissions (DVS and HVU) is 4.6 E-2 millirem per year and the abated dose is 2.3 E-5 millirem per year.

The unabated dose from diffuse and fugitive emissions from normal operations (staging/handling vented containers, installation of filters and sample ports using the Dart System, and manual excavation of contaminated soil) is 7.4 E-3 millirem per year and the abated dose is 4.3 E-3 millirem per year.

## 16.0 COST FACTORS OF CONTROL TECHNOLOGY COMPONENTS

*Provide cost factors for construction, operation, and maintenance of the proposed control technology components and system, if a BARCT or ALARACT demonstration is not submitted with the NOC.*

Cost factor inclusion is not applicable because the emission controls used during the TRU retrieval activities are HEPA filtration proposed as BARCT (Section 18.0) or are defined administratively and consist of ALARA techniques.

## 17.0 DURATION OR LIFETIME

*Provide an estimate of the lifetime for the facility process with the emission rates provided in this application.*

TRU waste retrieval activities at the LLBG are scheduled to take place between August 2003 and December 2014. Retrieval activities involving the horizontal V-notched trench configuration will be addressed prior to and part of the next phase of the NOC approval.

## 18.0 STANDARDS

*Indicate which of the following control technology standards have been considered and will be complied with in the design and operation of the emission unit(s) described in this application:*

ASME/ANSI AG-1

ASME/ANSI N509

ASME/ANSI N510

ANSI/ASME NQA-1

40 CFR 60, Appendix A, Methods 1, 1A, 2, 2A, 2C, 2D, 4, 5, and 17

ANSI N13.1.

The listed control technology standards have been considered and the administratively defined ALARA based emission controls proposed for these retrieval activities are adequate to limit and control emissions.

The NucFil filters used in the TRU retrieval project are certified by the manufacturer (99.97 % removal efficiency) and have been certified by WIPP and accepted by WDOH as BARCT. The DVS and the Dart System are proposed as BARCT for drum venting operations.

The exhaust vents of the DVS have HEPA-type filtration and have test ports for annual aerosol testing. AG-1 and ANSI N509 are not applicable to a cylindrical HEPA-type filter or passive system. The system is built to meet NQA-1 requirements and will be aerosol tested annually using ANSI N-510 as guidance for non-ANSI N-509 systems. If in-field aerosol testing is not feasible, an alternative would be to rely on

1 manufacturer certification of HEPA rating (99.97% efficiency) and replace the filters on an annual basis,  
2 in lieu of testing. There are no monitoring systems, thus the other listed standards are not applicable.

3  
4 The technology standards for HVUs are addressed under the NOC for these units (DOE/RL-97-50, as  
5 amended).

6  
7 Radiological surveys during and after activities and the 200 Area Near-Field Monitoring network are  
8 proposed as adequate to monitor for protection of the public and environment.

## 11 19.0 REFERENCES

12 02-RCA-096, letter, J. B. Hebdon, U. S. Department of Energy, Richland Operations Office, to  
13 A. W. Conklin, Washington State Department of Health, J. M. Leitch, U. S. Environmental  
14 Protection Agency, Region 10 and O. S. Wang, Washington State Department of Ecology,  
15 DOE/RL-2001-57, Revision 1, *Radioactive Air Emissions Notice of Construction for the*  
16 *Transuranic Waste Retrieval Project*, December 18, 2001.

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19 *Operations Office*, November 2000, U.S. Department of Energy, Richland, Washington.

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21 DOE/RL-97-50, Rev. 1, *Radioactive Air Emissions Notice of Construction for HEPA Filtered Vacuum*  
22 *Radioactive Air Emission Units*, September 1999, U.S. Department of Energy, Richland,  
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25 DOE/RL-2000-34, Rev. 1, *Radioactive Air Emissions Notice of Construction Application for the Waste*  
26 *Receiving and Processing Facility*, April 2001, U.S. Department of Energy, Richland, Washington.

27  
28 DOE/RL-2001-32, *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2000*,  
29 June 2001, U.S. Department of Energy, Richland, Washington.

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31 HNF-2418, *Soil Contamination Standards for Protection of Personnel*, March 1998, Fluor Hanford,  
32 Richland, Washington.

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34 HNF-3580, *Hanford Contact Handled Transuranic Drum Retrieval Project Planning Document*,  
35 November 1998, Fluor Hanford, Richland, Washington.

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37 HNF-3602, Rev. 1, *Calculating Potential-to-Emit releases and Doses for FEMPs and NOCs*,  
38 February 2002, Fluor Hanford, Richland, Washington.

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40 HNF-5597, *Process Description for the Retrieval of Earth-Covered Transuranic Waste Containers at the*  
41 *Hanford Site*, January 2000, Fluor Hanford, Richland, Washington.

42  
43 HNF-7165, *Corrosion Rates and Inspection Frequencies for Steel Drums in the Hanford Site Solid Waste*  
44 *Burial Grounds*, August 2001, Fluor Hanford, Richland, Washington.

45  
46 HNF-12180, Rev. 1, *Venting System for Low Level Burial Grounds Performance Specification*,  
47 April 2003, Fluor Hanford, Richland, Washington.

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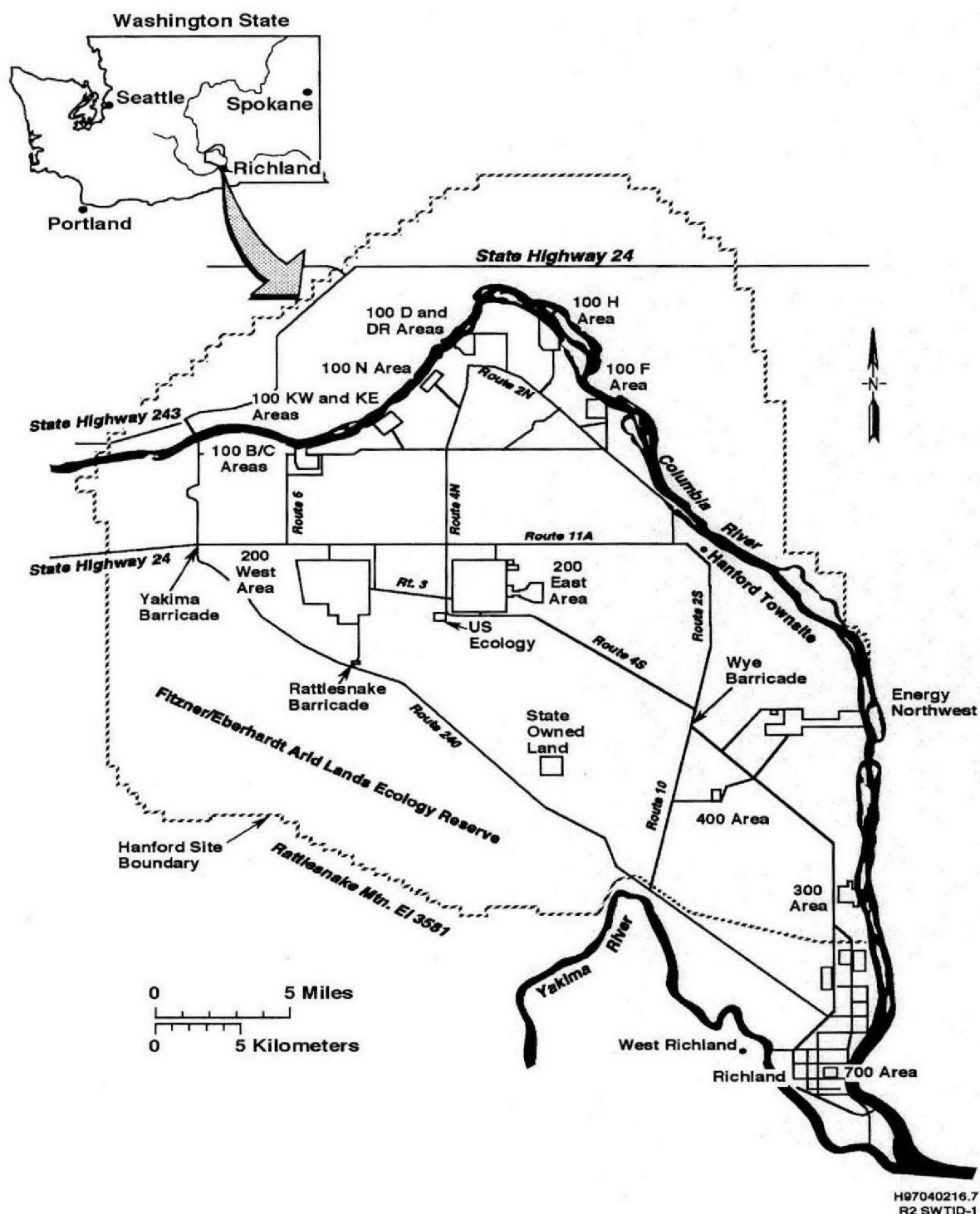


Figure 1. Hanford Site.



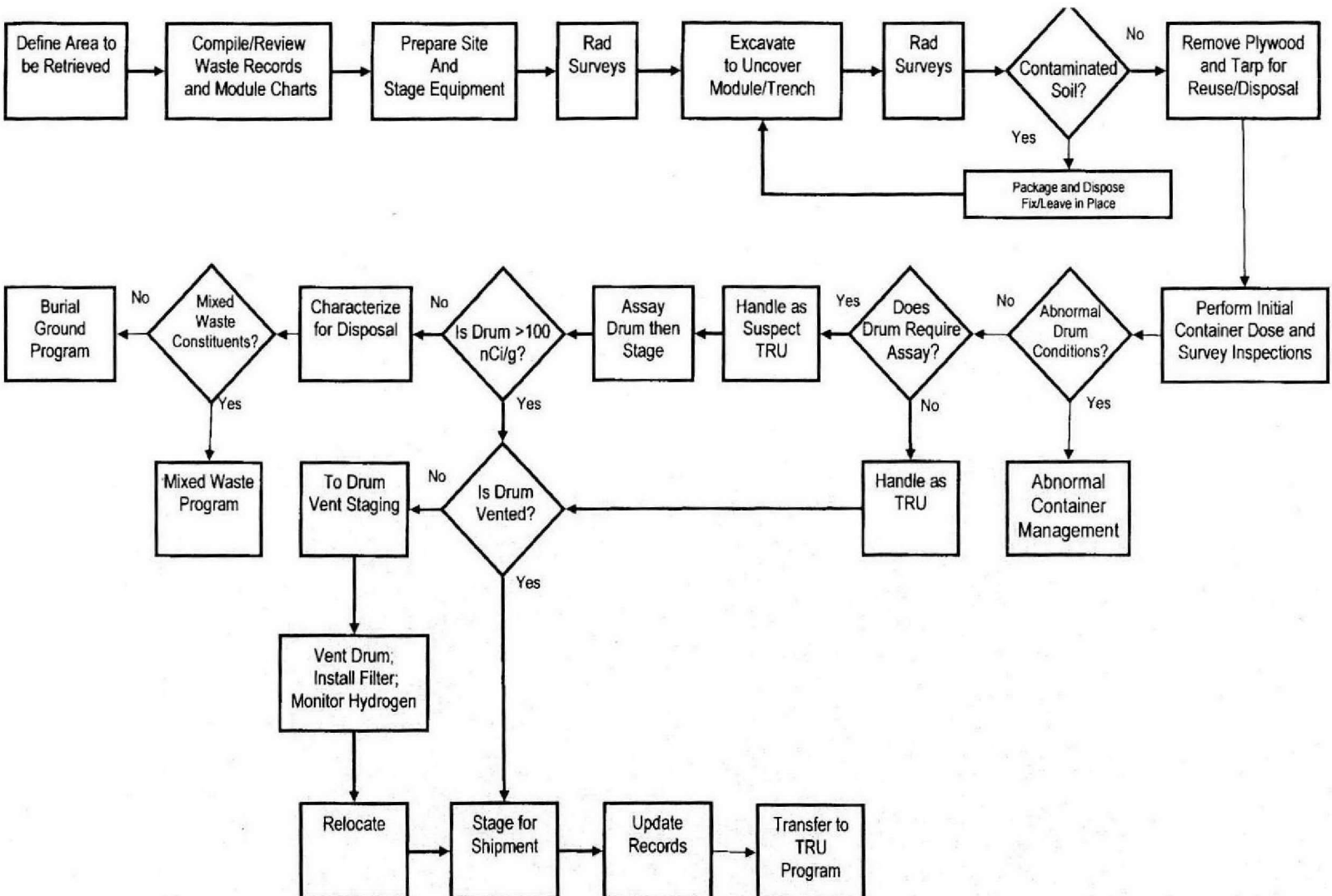


Figure 2. Simplified Transuranic Waste Retrieval Flow Diagram.

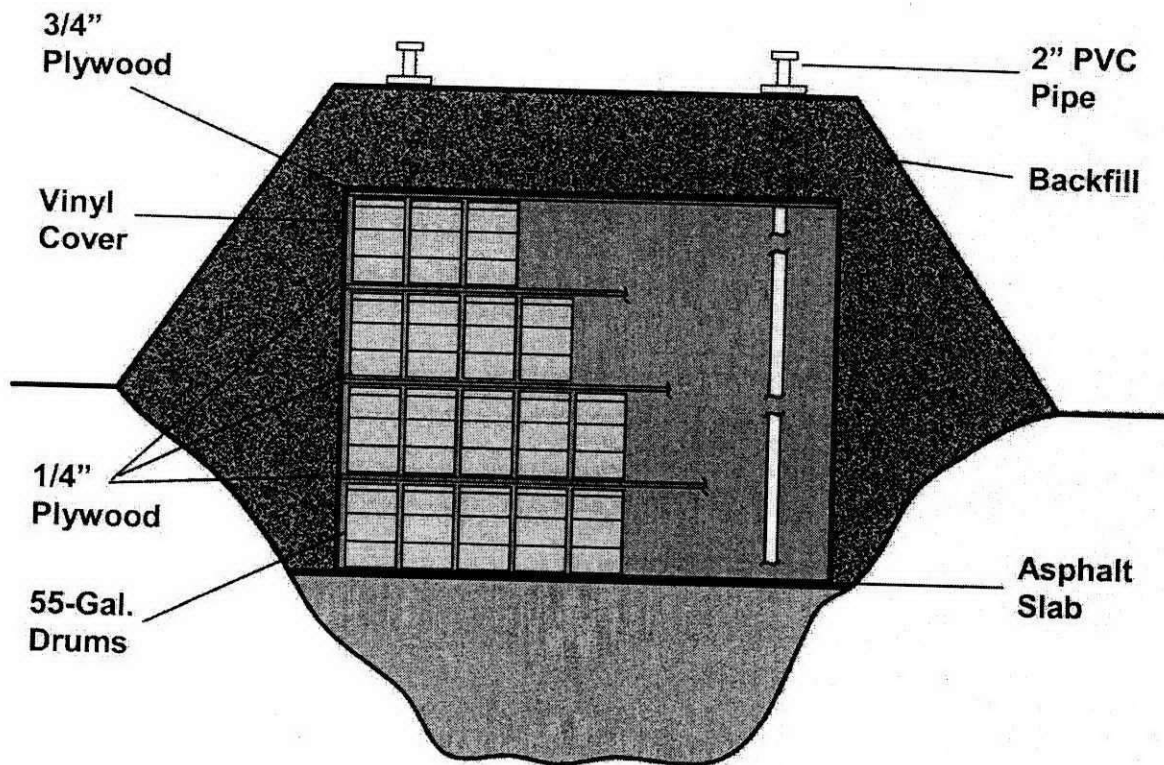


Figure 3. Typical Post-1970 Transuranic Waste Interim Storage.

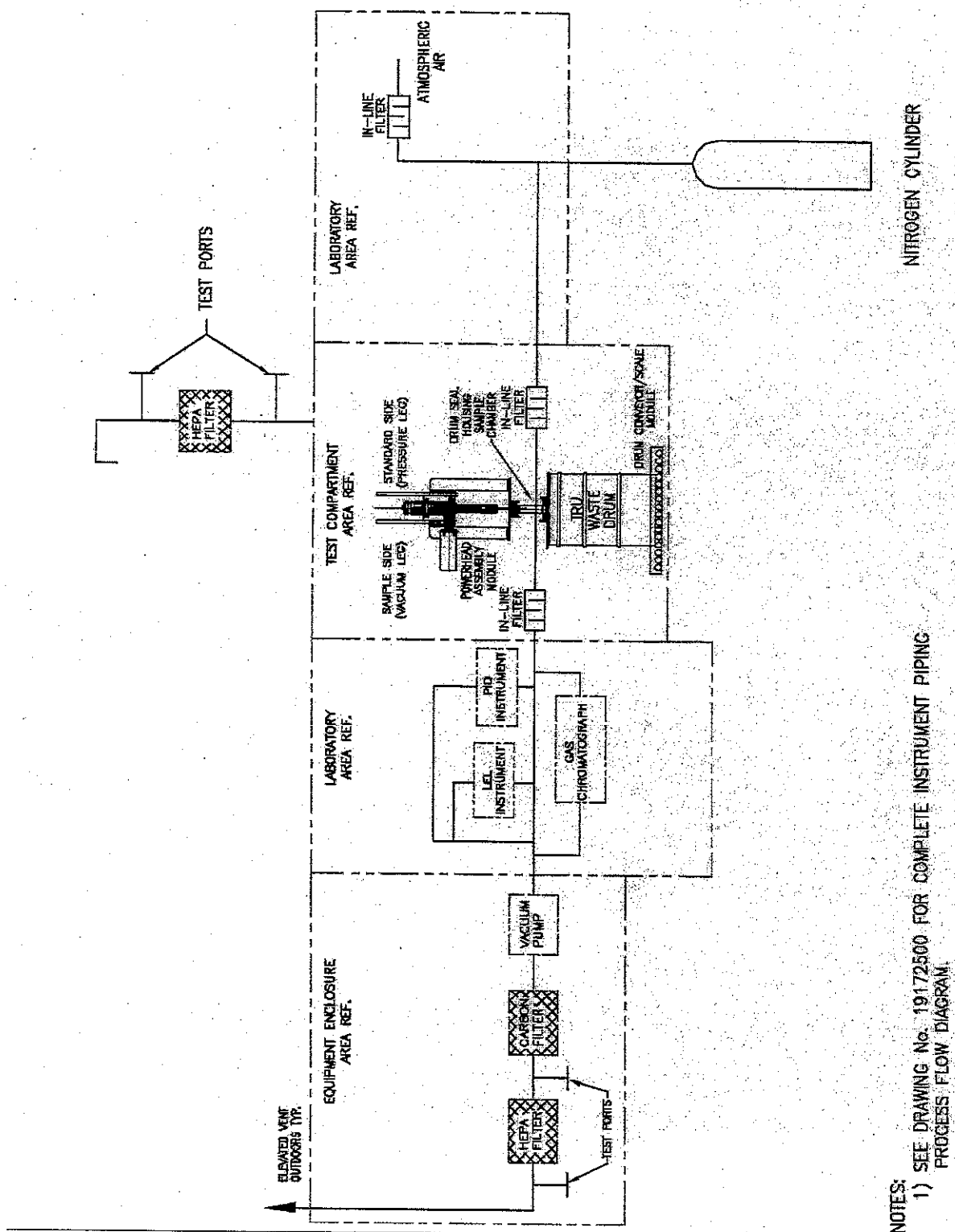


Figure 4. Simplified TRU Retrieval Drum Venting Process Flow Diagram.

Table 1. Transuranic Waste Retrieval Project Point Source and Diffuse/Fugitive Release Rates and Dose Estimates.

PTE for Diffuse/Fugitive Emissions from Staging/Handling of Vented Containers											
Radionuclide	Assumed Isotope	Average Ci/Container	Containers/year	Estimated Inventory (Ci)		Release Fraction	Unabated Release Rate (Ci/yr)	Abated Release Rate (Ci/yr)	Unit Dose Factor (mrem/Ci)	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Alpha Emitters	Am-241	1.25	11,000	1.38E+04		2.00E-09	2.8E-05	2.8E-05	1.7E+01	4.7E-04	4.7E-04
Beta Emitters	Cs-137	18.75	11,000	2.06E+05		2.00E-09	4.1E-04	4.1E-04	3.1E-01	1.3E-04	1.3E-04
Subtotal		20					4.4E-04	4.4E-04		6.0E-04	6.0E-04
PTE for Installation of NucFil Filters (Point Source DVS, Active Vent)											
Radionuclide	Assumed Isotope	Average Ci/Container	Containers/year	Estimated Inventory (Ci)	Time Factor (containers per year * 20 min/drum)	Release Fraction	Unabated Release Rate (Ci/yr)	Abated Release Rate (Ci/yr)	Unit Dose Factor (mrem/Ci)	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Alpha Emitters	Am-241	1.25	9,000	1.13E+04	3.42E-01	1.00E-03	4.3E-04	2.1E-07	1.7E+01	7.3E-03	3.6E-06
Beta Emitters	Cs-137	18.75	9,000	1.69E+05	3.42E-01	1.00E-03	6.4E-03	3.2E-06	3.1E-01	2.0E-03	9.9E-07
Subtotal		20					6.8E-03	3.4E-06		9.3E-03	4.6E-06
PTE for Installation of NucFil Filters (Point Source DVS, Passive Vent)											
Radionuclide	Assumed Isotope	Average Ci/Container	Containers/year	Estimated Inventory (Ci)		Release Fraction	Unabated Release Rate (Ci/yr)	Abated Release Rate (Ci/yr)	Unit Dose Factor (mrem/Ci)	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Alpha Emitters	Am-241	4.8E-11	9,000	4.32E-07		1.00E+00	4.3E-07	2.2E-10	1.7E+01	7.3E-06	3.7E-09
Beta Emitters	Cs-137	2.4E-09	9,000	2.16E-05		1.00E+00	2.2E-05	1.1E-08	3.1E-01	6.7E-06	3.3E-09
Subtotal							2.2E-05	1.1E-08		1.4E-05	7.0E-09
PTE for Installation of NucFil Filters (Diffuse/Fugitive Dart System)											
Radionuclide	Assumed Isotope	Average Ci/Container	Containers/year	Estimated Inventory (Ci)	Time Factor (containers per year * 1 hr/drum)	Release Fraction	Unabated Release Rate (Ci/yr)	Abated Release Rate (Ci/yr)	Unit Dose Factor (mrem/Ci)	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Alpha Emitters	Am-241	1.25	1,000	1.25E+03	1.14E-01	1.00E-03	1.4E-04	4.8E-08	1.7E+01	2.4E-03	8.1E-07
Beta Emitters	Cs-137	18.75	1,000	1.88E+04	1.14E-01	1.00E-03	2.1E-03	7.1E-07	3.1E-01	6.6E-04	2.2E-07
Subtotal		20					2.3E-03	7.6E-07		3.1E-03	1.0E-06

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Table 1. Transuranic Waste Retrieval Project Point Source and Diffuse/Fugitive Release Rates and Dose Estimates (continued).

PTE for Diffuse/Fugitive Emissions from Excavation (Contamination Detected)											
Radionuclide	Assumed Isotope	Average Concentration (dpm/100 cm <sup>2</sup> )	Estimated Soil Concentration (pCi/g)	Soil Volume (m <sup>3</sup> /yr)	Soil Density (g/m <sup>3</sup> )	Release Fraction	Unabated Release Rate (Ci/yr)	Abated Release Rate (Ci/yr)	Unit Dose Factor (mrem/Ci)	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Alpha Emitters	Am-241	100	2.13E+02	100	1.57E+06	1.00E-03	3.3E-05	3.3E-05	1.7E+01	5.7E-04	5.7E-04
Beta Emitters	Cs-137	5,000	1.41E+03	100	1.57E+06	1.00E-03	2.2E-04	2.2E-04	3.1E-01	6.9E-05	6.9E-05
Subtotal							2.5E-04	2.5E-04		6.4E-04	6.4E-04
PTE for Diffuse/Fugitive Emissions from Excavation (Higher Contamination Level, Controls Required)											
Radionuclide	Assumed Isotope	Average Concentration (dpm/100 cm <sup>2</sup> )	Estimated Soil Concentration (pCi/g)	Soil Volume (m <sup>3</sup> /yr)	Soil Density (g/m <sup>3</sup> )	Release Fraction	Unabated Release Rate (Ci/yr)	Abated Release Rate (Ci/yr)	Unit Dose Factor (mrem/Ci)	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Alpha Emitters	Am-241	2,000	4.26E+03	10	1.57E+06	1.00E-03	6.7E-05	6.7E-05	1.7E+01	1.1E-03	1.1E-03
Beta Emitters	Cs-137	100,000	2.82E+04	10	1.57E+06	1.00E-03	4.4E-04	4.4E-04	3.1E-01	1.4E-04	1.4E-04
Subtotal							5.1E-04	5.1E-04		1.3E-03	1.3E-03
PTE for Diffuse/Fugitive Emissions from Excavation (Notification Level)											
Radionuclide	Assumed Isotope	Average Concentration (dpm/100 cm <sup>2</sup> )	Estimated Soil Concentration (pCi/g)	Soil Volume (m <sup>3</sup> /yr)	Soil Density (g/m <sup>3</sup> )	Release Fraction	Unabated Release Rate (Ci/yr)	Abated Release Rate (Ci/yr)	Unit Dose Factor (mrem/Ci)	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Alpha Emitters	Am-241	28,000	5.96E+04	1	1.57E+06	1.00E-03	9.4E-05	9.4E-05	1.7E+01	1.6E-03	1.6E-03
Beta Emitters	Cs-137	500,000	3.95E+05	1	1.57E+06	1.00E-03	6.2E-04	6.2E-04	3.1E-01	1.9E-04	1.9E-04
Subtotal							7.1E-04	7.1E-04		1.8E-03	1.8E-03
Manual Excavation Summary											
Alpha Emitters	Am-241					1.00E-03	1.9E-04	1.9E-04	1.7E+01	3.3E-03	3.3E-03
Beta Emitters	Cs-137					1.00E-03	1.3E-03	1.3E-03	3.1E-01	4.0E-04	4.0E-04
Manual Excavation Diffuse/Fugitive Subtotal										3.7E-03	3.7E-03
HVU Use Point Source (1% of Manual Excavation Subtotal)											
Alpha Emitters	Am-241					1.00E+00	1.9E-03	9.7E-07	1.7E+01	3.3E-02	1.6E-05
Beta Emitters	Cs-137					1.00E+00	1.3E-02	6.4E-06	3.1E-01	4.0E-03	2.0E-06
HVU Use Subtotal										3.7 E-02	1.8E-05

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Table 1. Transuranic Waste Retrieval Project Point Source and Diffuse/Fugitive Release Rates and Dose Estimates (continued).

PTE Summary		
	Unabated Dose (mrem/yr)	Abated Dose (mrem/yr)
Total Point Source Emissions (DVS and HVUs)	4.6E-02	2.3E-05
Total Diffuse and Fugitive (Normal Operations from Staging, Dart System, and Manual Excavation)	7.4E-03	4.3E-03

Legend for Table 1:

Ci = curie(s).  
 Ci/yr = curies per year.  
 dpm/100 cm<sup>2</sup> = disintegrations per minute per 100 square centimeters.  
 DVS = drum venting system  
 g = gram.  
 hr = hour.  
 HEPA = high-efficiency particulate air (filter)  
 HVU = HEPA-filtered Vacuum Unit  
 m<sup>3</sup> = cubic meters.  
 mrem/Ci = millirem per curie.  
 mrem/yr = millirem per year.  
 pCi/g = picocuries per gram.  
 PTE = potential-to-emit.  
 yr = year.

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